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Investigation and treatment of ovine psoroptic otoacariasis

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Abstract

Background- Psoroptic otoacariasis has been described world-wide and is caused by a mite morphologically indistinguishable from the sheep scab mite *Psoroptes ovis*. A single treatment of affected sheep with 200 µg/kg of injectable ivermectin is reported to be curative.

Case report- *Psoroptes* mites were isolated following treatment with ivermectin but treatment with moxidectin at 1mg/kg caused complete cessation of clinical signs. Affected animals were seropositive to Pso o2 antigen ELISA, and had serum haptoglobin concentrations that overlapped with those described for field infections of classical sheep scab.

Conclusions and clinical importance- Psoroptic otoacariasis is not controlled by single treatments of injectable ivermectin but resolves after a single treatment with injectable moxidectin. Pso o 2 ELISA can detect infection with *Psoroptes* spp. mites but cannot distinguish between sheep scab and psoroptic otoacariasis.

Background

Psoroptic otoacariasis has been described in domestic sheep (*Ovis aries*) in the UK, France, Germany, Brazil and Israel.^{1,2,3} It is also a widespread problem among Bighorn sheep (*Ovis canadensis*).^{4, 5} Opinions differ whether the causative mite should be classified as a strain of *Psoroptes ovis* (the sheep scab mite) or of *Psoroptes cuniculi* (the rabbit ear mite) or whether these are homospecific.⁶

Clinical signs of psoroptic otoacariasis include brown crusts in the external auditory meatus (EAM), aural pruritus and subsequent secondary changes.^{1, 3} The majority of the mites are found close to the tympanic membrane.⁷ Diagnosis is by isolation of mites. There are no licensed products for the treatment of psoroptic otoacariasis. Unlike sheep scab, it does not respond to plunge-dipping in organophosphates but is reported to be cured by single injections of ivermectin at 200 µg/kg compared with sheep scab for which two injections at a seven-ten day interval are required^{1,8, 9}.

Case report

The owner of a small pedigree Wensleydale flock requested investigation of aural pruritus and hair loss affecting the majority of the flock in October 2013. Psoroptic mange (sheep scab) had not been diagnosed previously in the flock or in any neighbouring holdings; only two animals had been introduced during the previous 5 years. The owner reported two previous outbreaks of similar disease in 1992 and 2002. On both occasions injectable moxidectin treatment was reportedly successful.

The flock was first visited on 14th October 2013 and all of the sheep were examined. This confirmed the presence of lesions of the pinnae and EAM consistent with psoroptic otoacariasis. The yellow scabs typically associated with sheep scab were not seen. Affected EAM were swabbed as previously described; a sterile, cotton-tipped, bacteriology swab was gently inserted into the EAM, rotated and then withdrawn, with any loose debris in the EAM also collected.¹ All sheep were blood sampled using plain vacutainers. The swabs and any debris recovered were examined microscopically. The serum samples were analysed for anti-Pso o 2

antibody by ELISA as previously described and for haptoglobin using a commercial colorimetric assay (Tridelta PHASE Haptoglobin Assay; Tridelta Development Ltd, Maynooth, Co.Kildare, Republic of Ireland).¹⁰ Haptoglobin is an acute phase protein and as such is a non-specific marker of inflammation. Levels are known to be elevated in sheep with active sheep scab infection and drop rapidly after successful treatment.¹¹ All sheep were treated with subcutaneous injection of ivermectin at 200 µg/kg (Panomec Injection for Cattle, Sheep & Pigs, Merial Animal Health Ltd, Harlow, Essex, UK).

Clinical signs reappeared and worsened within 1 month. The flock was visited again and deep skin scrapings were taken from the hyperkeratotic areas of affected animals. One animal had died and three had been sold between the first and second visits. Both ears of all sheep with visible lesions were flushed following a previously described method; in brief a length of flexible rubber tubing was gently inserted into the EAM and 60 ml of sterile saline was instilled using a syringe, overflow from the ear was captured and negative pressure applied to withdraw as much of the flushing fluid as possible, which was then pooled with the overflow fluid.² Repeat blood samples were collected from all animals with visible lesions. All sheep in the flock were treated with 1 mg/kg moxidectin (Cydectin 20 mg/ml LA Solution for Injection for Sheep, Zoetis UK Ltd, London, UK). Ears were scored at both visits. An arbitrary 0-3 score was given to each ear using the following criteria: 0- no visible lesion; 1 - alopecia and crusting at the ear base; 2 - more extensive alopecia and crusting and the presence of dark brown scabs; 3 - fibrosis and thickening of the pinna, complete occlusion of the external auditory meatus and the presence of several dark brown scabs. Individuals were assigned a score by summing their ear scores. Sheep were classified as lesions present/absent and as lamb (<1 year old) or adult (> 1 year old). Statistical analysis was performed using Minitab 16 (Minitab Inc., State College, PA, USA). Proportions of affected sheep were compared by 2-proportions test, haptoglobin concentration and ELISA titre variation between animals were analysed by 2-sample t-test, and within animals over time by paired t-test; correlation between these variables was analysed by a Pearson test. Comparison to previously published results was performed using a 1-sample t-test.

At the first visit 11/23 animals had visible lesions; at the second visit 14/19. A statistically significantly higher fraction of adult sheep than lambs had score 3 lesions on both dates ($p=0.043$ and $p=0.012$ respectively).

No mites were isolated from the swabs or skin scrapes. 3 mites were isolated from 2 animals by flushing. These were morphologically consistent with *Psoroptes ovis* tritonymphs.

Pso o 2 titres which exceeded twice the optical density of the negative control (0.21) sample were considered sero-positive. At the first sampling, 6/18 samples were sero-positive, whilst 7/12 were positive at the second sampling. Not all Pso o 2 or haptoglobin results could be assigned to specific individuals due to mismatches between sheep ear tag numbers and label numbers. There was no statistically significant difference between the two sets of Pso o2 ELISA titres ($p=0.209$), or when the identified samples were compared ($p=0.591$).

The mean haptoglobin concentration was 0.47 mg/ml at first sampling and 0.24 mg/ml at second sampling, the haptoglobin concentrations were statistically

significantly different ($p=0.019$). There was no difference between the haptoglobin concentrations at first sampling and the pre-infestation mean (0.30mg/ml) previously described ($p=0.072$), though some results were higher than those described for field-acquired sheep scab.¹¹ There was no correlation between Pso o2 titre and haptoglobin concentration at either date ($p=0.402$, $p=0.759$ respectively). The presence of ear lesions and the age of the animal did not appear to have a significant effect on the likelihood of a positive Pso o 2 ELISA result or the serum haptoglobin concentration.

After ivermectin treatment a temporary reduction of the degree of pruritus was observed but clinical signs resumed within 1 month. After moxidectin treatment the owner reported a cessation of signs in all sheep. To date (an 18 month period) none have shown further signs of aural pruritus.

Discussion

The appearance and age distribution of clinical signs were similar to those described previously.¹ The lack of lesions or history of sheep scab suggests the mites isolated are a fully ear-adapted strain.

Swabbing failed to detect any mites, flushing isolated mites from two animals. This is similar to a previous report of psoroptic otoacariasis in Brazilian sheep.² Only sheep with visible lesions were swabbed or flushed, as this investigation began as an investigation of the cause of the clinical signs. This is likely to have missed infected sheep as ear mites have been isolated from sheep showing no clinical signs of otoacariasis.¹ Animals with lesions may be those which are hypersensitive and thus responding strongly to a relatively small number of mites. Mites were recovered from 10.5% (2/19) animals, which is lower than previously reported (46%-83%).² This, and the fact that only immature stages were isolated, is consistent with ivermectin treatment eradicating the adult mites which were then replaced by newly hatched mites.

Previously, cessation of pruritus and elimination of living mites from the ear canal following a single injection of ivermectin (200 µg/kg bw), has been reported for ovine psoroptic otoacariasis.¹ This is in contrast to the situation with sheep scab. Injectable moxidectin, both in the 1% and 2% formulation, is widely used for the treatment and control of sheep scab.^{12, 13, 14} Similarly, a sustained release ivermectin implant has been successfully used to treat psoroptic otoacariasis in Bighorn sheep.¹⁵ The period of persistent activity of 1% moxidectin against infection by *P. ovis* is 35 days; this is longer than the incubation period of *P. ovis* eggs and the maximum survival period of the mite away from the host.^{12,13,16,17, 18}

Several animals at each sampling were seropositive for anti-Pso o 2 antibodies in a flock with no clinical history of sheep scab. These results suggest that positive Pso o2 ELISA results indicate either sheep scab or psoroptic otoacariasis, as has previously been described for crude *Psoroptes* antigen ELISAs in both domestic and Bighorn sheep.^{19, 20, 21} Anti-*P. ovis* antibody ELISAs have been proposed for the detection of asymptomatic sheep scab infections; these results suggest that such a test cannot distinguish between these two *Psoroptes* spp. infections.^{10,22}

Haptoglobin concentrations in sheep artificially infected with sheep scab increased to above 3 mg/ml, well above that of any sheep in this investigation.¹¹ However the

range of concentrations seen at the first sampling did overlap that described for naturally acquired sheep scab infection, as would be expected from an active infection.¹¹

There was no difference in the proportion of animals with positive Pso o 2 ELISA titres at the first and second sampling. This is unsurprising given the first treatment was unsuccessful in eliminating infection and that circulating anti-*Psoroptes* antibody levels drop over a period of weeks to months after successful treatment in cases of sheep scab and Bighorn otoacariasis.^{20, 22, 23} Haptoglobin levels fell between first and second sampling; this would be consistent with ivermectin killing the adult mites and so temporarily reducing the antigenic stimulation.

Conclusions and clinical importance

Psoroptic otoacariasis is an uncommon parasitic infection of sheep causing clinical signs related to aural pruritus. Mites may be most successfully isolated ante-mortem by flushing of the external auditory meatus. Treatment with ivermectin was unsuccessful in this case; moxidectin treatment resulted in the resolution of clinical signs. Ear mite infection resulted in positive titres using the recombinant Pso o2 ELISA test.

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Figure captions

Figure 1.

This figure shows the range of lesions associated with psoroptic otoacariasis in this case. Top: A score 1 lesion- alopecia and crusting at the ear base. Middle: A score 2 lesion with more extensive alopecia and crusting and the presence of dark brown scabs. Bottom: A score 3 lesion with fibrosis and thickening of the pinna, complete occlusion of the external auditory meatus and the presence of several dark brown scabs. Ears without any visible lesions received a score of 0.

Table 1.

This table shows the total ear lesion score, age of affected sheep and Pso o2 ELISA titres and haptoglobin concentrations where these could be ascribed to individual animals. The negative control OD was 0.21, the positive control OD was 2.0. Pso o2 values which were considered to be positive are in **bold**. Sheep which were absent from the flock in December (dead or sold) are denoted by N/A in the applicable cells.